PATENT
Customer No. 22,852
Attorney Docket No. 08303.0042-00000

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

| | | |
|---|---|---|
| In re Reissue Application of: | ) | |
| | ) | |
| Jonathan D. ZOOK et al. | ) | Prior Group Art Unit: 1711 |
| | ) | |
| Original Patent No.: 5,912,319 | ) | Prior Examiner: Duc Truong |
| | ) | |
| Original Patent Issue Date: June 15, 1999 | ) | |
| | ) | |
| Reissue Filing Date: February 25, 2004 | ) | |
| | ) | |
| For: COMPOSITIONS AND METHOD FOR PRODUCING FUEL RESISTANT LIQUID POLYTHIOETHER POLYMERS WITH GOOD LOW TEMPERATURE FLEXIBILITY | ) | |

Commissioner for Patents
Washington, DC 20231

Sir:

**AMENDMENT**

Prior to the examination of the above-referenced reissue application, please amend this reissue application as follows:

**Amendments to the Abstract** begin on page 2 of this paper.

**Amendments to the Specification** begin on page 3 of this paper.

**Amendments to the Claims** begin on page 10 of this paper.

**Remarks** begin on page 16 of this paper.

**Amendments to the Abstract**

A polythioether includes a structure having the formula I

$$-R^1-[-S-(CH_2)_2-O-[-R^2-O-]_m-(CH_2)_2-S-R^1-]_n- \quad I$$

wherein

$R^1$ denotes a divalent $C_{2-6}$ n-alkylene, $C_{3-6}$ branched alkylene, $C_{6-8}$ cycloalkylene or $C_{6-10}$ alkylcycloalkylene group, $-[(-CH_2-)_p-X-]_q-(-CH_2-)_r-$, or $-[(-CH_2-)_p-X-]_q-(-CH_2-)_r-$ in which at least one $-CH_2-$ unit is substituted with a methyl group,

$R^2$ denotes methylene, a divalent $C_{2-6}$ n-alkylene, $C_{2-6}$ branched alkylene, $C_{6-8}$ cycloalkylene or $C_{6-10}$ alkylcycloalkylene group, $-[(-CH_2-)_p-X-]_q-(-CH_2-)_r-$, or $-[(-CH_2-)_p-X-]_q-(-CH_2-)_r-$ in which at least one $-CH_2-$ unit is substituted with a methyl group,

X denotes one selected from the group consisting of O, S and $-NR^6-$,

$R^6$ denotes H or methyl,

m is a rational number from 0 to 10,

n is an integer from 1 to 60,

p is an integer from 2 to 6,

q is an integer from 1 to 5, and

r is an integer from 2 to 10.

The polythioether is a liquid at room temperature and pressure.

**Amendments to the Specification**

*Col. 2, lines 21-47.*

In accordance with one aspect of the present invention, there is provided a polythioether having the formula I

$$-R^1-[-S-(CH_2)_2-O-[-R^2-O-]_m-(CH_2)_2-S-R^1-]_n- \quad \text{I}$$

wherein

$R^1$ denotes a divalent $C_{2-6}$ n-alkylene, $C_{3-6}$ branched alkylene, $C_{6-8}$ cycloalkylene or $C_{6-10}$ alkylcycloalkylene group, $-[(-CH_2-)_p-X-]_q-(-CH_2-)_r-$, or $-[(-CH_2-)_p-X-]_q-(-CH_2-)_r-$ in which at least one $-CH_2-$ unit is substituted with a methyl group,

$R^2$ denotes methylene, a divalent $C_{2-6}$ n-alkylene, $C_{2-6}$ branched alkylene, $C_{6-8}$ cycloalkylene or $C_{6-10}$ alkylcycloalkylene group, $-[(-CH_2)_p-X-]_q-(-CH_2-)_r-$, or $-[(-CH_2)_p-X-]_q-(-CH_2-)_r-$ in which at least one $-CH_2-$ unit is substituted with a methyl group, X denotes one selected from the group consisting of O, S and $-NR^6-$,

$R^6$ denotes H or methyl,

m is a rational number from 0 to 10,

n is an integer from 1 to 60,

p is an integer from 2 to 6,

q is an integer from 1 to 5, and

r is an integer from 2 to 10,

the polythioether being a liquid at room temperature and pressure.

*Co. 2, lines 50-65*

In a first preferred embodiment, the polythioether has the formula II

$$A-(-[R^3]_y-R^4)_2 \qquad \text{II}$$

wherein

A denotes a structure having the formula I,

y is 0 or 1,

$R^3$ denotes a single bond when y=0 and $-S-(CH_2)_2-[-O-R^2-]_m-O-$ when y=1,

$R^4$ denotes –SH or $-S-(-CH_2-)_2-O-R^5$ when y=0 and [[$-CH_2=CH_2$]] $-CH=CH_2$ or $-(CH_2-)_2-S-R^5$ when y=1,

$R^5$ denotes $C_{1-6}$ n-alkyl which is unsubstituted or substituted with at least one –OH or –$NHR^7$ group, and

$R^7$ denotes H or a $C_{1-6}$ n-alkyl group.

*Col. 3, lines 25-43*

In a second preferred embodiment, the polythioether has the formula III

$$[[A-(-[R^3]_y-R^4)_z]] \qquad A-(-[R^3]_y-R^4)_z \qquad \text{III}$$

wherein

A denotes a structure having the formula I,

y is 0 or 1,

$R^3$ denotes a single bond when y=0 and $-S-(CH_2)_2-[-O-R^2-]_m-O-$ when y=1,

$R^4$ denotes –SH or –S–(–$CH_2$–)$_2$–O–$R^5$ when y=0 and [[–$CH_2$=$CH_2$]] –CH=$CH_2$ or –($CH_2$–)$_2$–S–$R^5$ when y=1,

$R^5$ denotes $C_{1-6}$ n-alkyl which is unsubstituted or substituted with at least one –OH or –$NHR^7$ group, and

$R^7$ denotes H or a $C_{1-6}$ n-alkyl group[[.]],

z is an integer from 3 to 6, and

B denotes a z-valent residue of a polyfunctionalizing agent.

*Col. 5, lines 25-50*

In their most general aspect, the inventive polythioethers include a structure having the formula I

$$-R^1-[-S-(CH_2)_2-O-[-R^2-O-]_m-(CH_2)_2-S-R^1-]_n- \quad \text{I}$$

wherein

$R^1$ denotes a divalent $C_{2-6}$ n-alkylene, $C_{3-6}$ branched alkylene, $C_{6-8}$ cycloalkylene or $C_{6-10}$ alkylcycloalkylene group, –[(–$CH_2$–)$_p$–X–]$_q$–(–$CH_2$–)$_r$–, or –[(–$CH_2$–)$_p$–X–]$_q$–(–$CH_2$–)$_r$– in which at least one –$CH_2$– unit is substituted with a methyl group,

$R^2$ denotes methylene, a divalent $C_{2-6}$ n-alkylene, $C_{2-6}$ branched alkylene, $C_{6-8}$ cycloalkylene or $C_{6-10}$ alkylcycloalkylene group, –[(–$CH_2$–)$_p$–X–]$_q$–(–$CH_2$–)$_r$–, or –[(–$CH_2$–)$_p$–X–]$_q$–(–$CH_2$–)$_r$– in which at least one –$CH_2$– unit is substituted with a methyl group,

X denotes one selected from the group consisting of O, S and –$NR^6$–,

$R^6$ denotes H or methyl,

m is a rational number from 0 to 10,

n is an integer from 1 to 60,

p is an integer from 2 to 6,

q is an integer from 1 to 5, and

r is an integer from 2 to 10.

*Col 6, lines 40-55*

A first preferred embodiment of the inventive polythioethers has the formula II

$$[[A-(-[R^3]-R^4)_2]] \qquad \underline{A-(-[R^3]_y-R^4)_2} \qquad \text{II}$$

wherein

A denotes a structure having the formula I,

y is 0 or 1,

$R^3$ denotes a single bond when y=0 and $-S-(CH_2)_2-[-O-R^2-]_m-O-$ when y=1,

$R^4$ denotes –SH or $-S-(-CH_2-)_2-O-R^5$ when y=0 and $[[-CH_2=CH_2]]$ $\underline{-CH=CH_2}$ or $-(CH_2-)_2-S-R^5$ when y=1,

$R^5$ denotes $C_{1-6}$ n-alkyl which is unsubstituted or substituted with at least one –OH or $-NHR^7$ group, and

$R^7$ denotes H or a $C_{1-6}$ n-alkyl group.

*Col. 7, lines 4-7*

In a more particular preferred embodiment of the foregoing polythioether, when m=1 and $R^2$ = n-butylene in formula II, $R^1$ is not ethylene or n-propylene. Also preferably, when m=1, p=2, q=2, r=2 and $R^2$ = ethylene, X is not O.

*Col. 7, line 53 to col. 8, line 4.*

Polyfunctional polythioethers according to the present invention thus preferably have the formula III

$$[[B-(-A-[R^3]-R^4)_z]] \quad \underline{B-(-A-[R^3]_y-R^4)_z} \qquad \text{III}$$

wherein

A denotes a structure having the formula I,

y is 0 or 1,

$R^3$ denotes a single bond when y=0 and $-S-(CH_2)_2-[-O-R^2-]_m-O-$ when y=1,

$R^4$ denotes –SH or $-S-(-CH_2-)_2-O-R^5$ when y=0 and $[[-CH_2=CH_2]]$ $\underline{-CH=CH_2}$ or $-(CH_2-)_2-S-R^5$ when y=1,

$R^5$ denotes $C_{1-6}$ n-alkyl which is unsubstituted or substituted with at least one –OH or –$NHR^7$ group,

$R^7$ denotes H or a $C_{1-6}$ n-alkyl group,

z is an integer from 3 to 6, and

B denotes a z-valent residue of a polyfunctionalizing agent.

*Col. 8, lines 63-67.*

The compounds of formula IV are dithiol compounds. Preferred dithiols include those compounds in which $R^1$ is a divalent $C_{2-6}$ n-alkylene group, i.e., 1,2-ethanedithiol, 1,3-propanedithiol, 1,4-butanedithiol, 1,5-pentanedithiol or 1,6-hexanedithiol.

*Col 9, lines 1-10.*

Additional preferred dithiols include those compounds in which $R^1$ is a divalent $C_{3-6}$ branched alkylene group, having one or more pendent groups which can be, for example, methyl or ethyl groups. Preferred compounds having branched alkylene $R^1$ include 1,2-propanedithiol, 1,3-butanedithiol, 2,3-butanedithiol, 1,3-pentanedithiol, 1,3-dithio-3-methylbutane and 2,3-butanedithiol. Other useful dithiols include those in which $R^1$ is a divalent $C_{6-8}$ cycloalkylene or $C_{6-10}$ alkylcycloalkylene group, for example, dipentenedimercaptan and ethylcyclohexyldithiol (ECHDT).

*Col. 9, lines 47-62.*

Exemplary divinyl ethers include those compounds in which $R^2$ is $C_{2-6}$ n-alkylene or $C_{2-6}$ branched alkylene. Preferred divinyl ethers of this type include ethylene glycol divinyl ether (EG-DVE) ($R^2$=ethylene, m=1); butanediol divinyl ether (BD-DVE) ($R^2$=butylene, m=1); hexanediol divinyl ether (HD-DVE) ($R^2$=hexylene, m=1); diethylene glycol divinyl ether (DEG-DVE) ($R^2$=ethylene, m=2); triethylene glycol divinyl ether ($R^2$=ethylene, m=3); and tetraethylene glycol divinyl ether ($R^2$=ethylene, m=4). Useful divinyl ether blends include "PLURIOL®" type blends such as PLURIOL® E-200 divinyl ether (commercially available from BASF), for which $R^2$=ethylene and m=3.8, as well as "DPE" polymeric blends such as

DPE-2 and DPE-3 (commercially available from International Specialty Products, Wayne, N.J.). Of these, DEG-DVE and PLURIOL® E-200 are particularly preferred.

*Col. 9, lines 63-67*

Useful divinyl ethers in which $R^2$ is $C_{2-6}$ branched alkylene can be prepared by reacting a polyhydroxy compound with acetylene. Exemplary compounds of this type include compounds in which $R^2$ is an alkyl-substituted methylene group such as $-CH_2(CH_3)-$ or $-CH_2CH(CH_3)-$.

*Col. 10, lines 52-59*

According to another preferred method, (n) equivalents of a compound having the formula [[!V]] IV, or a mixture of at least two different compounds having the formula IV, are reacted with (n+1) equivalents of a compound having the formula V, or a mixture of at least two different compounds having the formula V, again in the presence of an appropriate catalyst. This method affords an uncapped, vinyl-terminated difunctional polythioether.

**Amendments to the Claims**

1. (currently amended) A polythioether comprising a structure having the formula I

$$-R^1-[-S-(CH_2)_2-O-[-R^2-O-]_m-(CH_2)_2-S-R^1-]_n- \qquad I$$

wherein

$R^1$ denotes a divalent $C_{2-6}$ n-alkylene, $C_{3-6}$ branched alkylene, $C_{6-8}$ cycloalkylene or $C_{6-10}$ alkylcycloalkylene group, $-[(-CH_2-)_p-X-]_q-(-CH_2-)_r-$, or $-[(-CH_2-)_p-X-]_q-(-CH_2-)_r-$ in which at least one $-CH_2-$ unit is substituted with a methyl group,

$R^2$ denotes methylene, a divalent $C_{2-6}$ n-alkylene, $C_{2-6}$ branched alkylene, $C_{6-8}$ cycloalkylene or $C_{6-10}$ alkylcycloalkylene group, $-[(-CH_2)_p-X-]_q-(-CH_2-)_r-$, or $-[(-CH_2)_p-X-]_q-(-CH_2-)_r-$ in which at least one $-CH_2-$ unit is substituted with a methyl group,

X denotes one selected from the group consisting of O, S and $-NR^6-$,

$R^6$ denotes H or methyl,

m is a rational number from 0 to 10,

n is an integer from 1 to 60,

p is an integer from 2 to 6,

q is an integer from 1 to 5, and

r is an integer from 2 to 10,

said polythioether being a liquid at room temperature and pressure.

2. (original) The polythioether of claim 1 which has a glass transition temperature $T_g$ not higher than -50°C.

3. (original) The polythioether of claim 1 which, when cured, has a % volume swell not greater than 25% after immersion for one week in JRF type 1 at 60°C and ambient pressure.

4. (currently amended) The polythioether of claim 1 which has a number average molecular weight between about 500 and 20,000 Daltons.

5. (currently amended) The polythioether of claim 1 having the formula II

$$A - (- [R^3]_y - R^4)_2 \qquad II$$

wherein

A denotes a structure having the formula I,

y is 0 or 1,

$R^3$ denotes a single bond when y=0 and $-S-(CH_2)_2-[-O-R^2-]_m-O-$ when y=1,

$R^4$ denotes –SH or $-S-(-CH_2-)_2-O-R^5$ when y=0 and [[$-CH_2=CH_2$]] $-CH=CH_2$ or $-(CH_2-)_2-S-R^5$ when y=1,

$R^5$ denotes $C_{1-6}$ n-alkyl which is unsubstituted or substituted with at least one –OH or –$NHR^7$ group, and

$R^7$ denotes H or a $C_{1-6}$ n-alkyl group.

6. (original) The polythioether of claim 5 wherein y=0.

7. (original) The polythioether of claim 6 wherein $R^4$ is –SH.

8. (currently amended) The polythioether of claim 7 wherein (i) when m=1 and $R^2$= n-butylene, $R^3$ is not ethylene or n-propylene, and (ii) when m=1, p=2, q=2, r=2, and $R^2$= ethylene, X is not O.

9. (original) The polythioether of claim 6 wherein $R^4$ is $-S-(-CH_2-)_2-O-R^5$.

10. (original) The polythioether of claim 9 wherein $R^5$ is n-$C_2H_5$, n-$C_4H_9$–OH or n-$C_3H_7$–$NH_2$.

11. (original) The polythioether of claim 5 wherein y=1.

12. (original) The polythioether of claim 11 wherein $R^4$ is $-CH=CH_2$.

13. (original) The polythioether of claim 11 wherein $R^4$ is $-(CH_2-)_2-S-R^5$.

14. (original) The polythioether of claim 13 wherein $R^5$ is n-$C_3H_7$–OH.

15. (currently amended) The polythioether of claim 1 having the formula III

$$B-(-A-[R^3]_y-R^4)_z \qquad \text{III}$$

wherein

A denotes a structure having the formula I,

y is 0 or 1,

$R^3$ denotes a single bond when y=0 and $-S-(CH_2)_2-[-O-R^2-]_m-O-$ when y=1,

$R^4$ denotes –SH or $-S-(-CH_2-)_2-O-R^5$ when y=0 and [[$-CH_2=CH_2$]] $\underline{-CH=CH_2}$ or $-(CH_2-)_2-S-R^5$ when y=1,

$R^5$ denotes $C_{1-6}$ n-alkyl which is unsubstituted or substituted with at least one –OH or –$NHR^7$ group,

$R^7$ denotes H or a $C_{1-6}$ n-alkyl group,

z is an integer from 3 to 6, and

B denotes a z-valent residue of a polyfunctionalizing agent.

16. (original) The polythioether of claim 15 wherein z=3.

17. (original) The polythioether of claim 16 which has an average functionality from about 2.05 to 3.00.

18. (original) The polythioether of claim 15 wherein y=0.

19. (original) The polythioether of claim 18 wherein $R^4$ is –SH.

20. (original) The polythioether of claim 18 wherein $R^4$ is $-S-(-CH_2-)_2-O-R^5$.

21. (original) The polythioether of claim 15 wherein y=1.

22. (original) The polythioether of claim 21 wherein $R^4$ is $-CH=CH_2$.

23. (original) The polythioether of claim 21 wherein $R^4$ is $-(CH_2-)_2-S-R^5$.

24. (new) A polythioether comprising:

$$H-S-R^1-[-S-(CH_2)_2-O-(-R^2-O-)_m-(CH_2)_2-S-R^1-]_n-S-H$$

wherein

$R^1$ is selected from the group consisting of $C_{2-6}$ n-alkylene, and a $-[(-CH_2)_p-X]_q-(-CH_2)_r-$ group;

$R^2$ is selected from the group consisting of $C_{2-6}$ n-alkylene, and $C_{6-8}$ cycloalkylene;

X is selected from the group consisting of O and S;

m is an integer between 0 and 10;

p is an integer between 2 and 6;

q is an integer between 1 and 5;

r is an integer between 2 and 10; and

n is an integer between 1 and 60 selected so that the molecular weight of the polythioether is between 1,000 and 10,000 Daltons.

25. (new) The polythioether of claim 24 wherein $R^1$ is $C_2$-$C_6$ n-alkylene.

26. (new) The polythioether of claim 24 where $R^1$ is $-[(-CH_2-)_p-O-]_q-(-CH_2-)_r-$ where r, p, and q are 2.

27. (new) The polythioether of claim 24 wherein $R^2$ is $C_2$-alkyleneoxy.

28. (new) The polythioether of claim 24 wherein the molecular weight of said polythioether ranges from about 2,000 to about 5,000 Daltons.

29. (new) The polythioether of claim 24 having an atomic weight percentage ratio of C:S:O of 35-49 : 20-60 : 0-20.

30. (new) A mixture of polythioether polymers comprising a polythioether polymer having the formula

$$B-\{-S-R^1-[-S-(CH_2)_2-O-(R^2-O)_m-(CH_2)_2-S-R^1]_n-S-H\}_z$$

wherein

$R^1$ is selected from the group consisting of $C_{2-6}$ n-alkylene, and a $-[(-CH_2)_p-X]_q-(-CH_2)_r-$ group;

$R^2$ is selected from the group consisting of $C_{2-6}$ n-alkylene, and $C_{6-8}$ cycloalkylene;

X is selected from the group consisting of O and S;

m is an integer between 0 and 10;

p is an integer between 2 and 6;

q is an integer between 1 and 5;

r is an integer between 2 and 10;

z is an integer from 3 to 6;

B is a z-valent group of a polyfunctionalizing agent; and

n is an integer between 1 and 60 selected so that the molecular weight of the polythioether is between 1,000 and 10,000 Daltons.

31. (new) The polythioether mixture of claim 30 wherein z is 3.

32. (new) The polythioether mixture of claim 30 wherein the mixture has an average functionality between 3 and 4.

33. (new) The polythioether mixture of claim 30 wherein the average functionality is between 2.05 and 3.00.

34. (new) A curable composition comprising:

40 to 80 weight percent of a polythioether polymer according to claim 24;

5 to 60 weight percent of a filler; and

10 weight percent of a curing agent.

35. (new) The curable composition of claim 34 further comprising one or more additives selected from the group consisting of pigments, cure accelerators, adhesion promoters, thixotropic agents, and isopropyl alcohol.

## REMARKS

A copy of U.S. Patent No. 5,912,319 issued June 15, 1999, the subject patent of this Amendment, is attached as Appendix A.

By this Amendment, Applicants have amended claims 1, 4, 5, 8, and 15 of U.S. Patent No. 5,912,319, and have added new claims 24-35. Accordingly, claims 1-35 are pending in this reissue application.

Applicants have amended the Abstract, the paragraphs beginning on col. 2, line 21; col. 2, line 50; col. 3, line 25;col. 5, line 25; col. 6, line 40; col. 7, line 4; col. 7, line 53; col. 8, line 63; col. 9, line 1; col. 9, line 47; col. 9, line 63, and col. 10, line 52 of the specification, and claims 1 and 8 to properly refer to divalent radicals with the suffix "ene." Thus, for example, Applicants have amended reference to a divalent alkylene group rather than a monovalent alkyl group where appropriate.

In the '319 patent, various substituents are erroneously referred to as "alkyl" groups, whereas one skilled in the art will appreciate that the substituents are properly "alkylene" groups. An alkyl group is a According to the *IUPAC Compendium of Chemical Terminology* (2nd Edition 1997), an alkyl group is defined as a univalent group derived from alkanes by removal of a hydrogen atom form a carbon atom, e.g. $-C_nH_{2n+1}$. An alkylene group is defined as an alkanediyl group commonly but not necessarily having free valencies on adjacent carbon atoms, e.g., $-CH(CH)_3CH_2-$. *IUPAC Compendium of Chemical Terminology* (2nd Edition 1997). Regardless of the chemical nomenclature used, a person skilled in the chemical arts will appreciate that Applicants had intended to refer to alkylene and not alkyl groups. Thus, the amendment is not broadening, but rather simply corrects an error that would have been understood by one skilled in the art. It is the Applicants' position that the claims as filed meet the requirements of 35 U.S.C. § 112, and that the claims as amended herein more accurately reflect the terminology used in the art.

Applicants have included the superscript *y* in formula II at col. 6, line 42, and formula III at col. 7, line 56 to correct the inadvertent omission. Claims 5 and 15 and the corresponding support in the specification at col. 6, line 51, and col. 7, line 64, respectively, have been amended to properly refer to a $-CH=CH_2$ group, rather than a $-CH_2=CH_2$.

New claims 24-35 are presented for purposes of an interference with U.S. Patent No. 6,525,168 B2 (the '168 patent) and U.S. Application No. 10/368,135 (the '135 application). U.S. Patent No. 6,525, 168 B2, issued on February 25, 2003. U.S. Application No. 10/368,135 was published as Pub. No. 2003/0130480 A1 on July 10, 2003. Because an interference with an issued patent is requested in papers filed contemporaneously herewith, Applicants respectfully request that examination of the present reissue application be expedited.

Applicants' new claims 24-35 are drawn to a single patentable invention. Specifically, the patentable invention encompasses polythioether polymers and curable compositions comprising polythioether polymers where the polythioether polymers have the structure of H–S–$R^1$–[–S–$(CH_2)_2$–O–(–$R^2$–O–)$_m$–$(CH_2)_2$–S–$R^1$–]$_n$–S–H, and mixtures of polythioether polymers comprising B–{–S–$R^1$–[–S–$(CH_2)_2$–O–$(R^2$–O)$_m$–$(CH_2)_2$–S–$R^1$]$_n$–S–H}$_z$, where the constituents are as defined in the claims.

In accordance with 37 C.F.R. § 1.173(c), Applicants respectfully submit that support for the new claims can be found in the specification and in the claims of U.S. Patent No. 5,912,319, including but not limited to:

| *Claim 24 of the Present Reissue Application* | *Representative Support in U.S. 5,912,319* |
|---|---|
| A polythioether comprising:<br><br>H–S–$R^1$–[–S–$(CH_2)_2$–O–(–$R^2$–O–)$_m$–$(CH_2)_2$–S–$R^1$–]$_n$–S–H<br><br>wherein | "In their most general aspect, the inventive polythioethers include a structure having the formula I<br>–$R^1$–[–S–$(CH_2)_2$–O–[–$R^2$–O–]$_m$–$(CH_2)_2$–S–$R^1$–]$_n$– "<br>*Col. 5, lines 24-27.*<br><br>*Claim 5.*<br><br>"A first preferred embodiment of the inventive polythioethers has the formula II<br><br>A – (– [$R^3$] – $R^4$)$_2$ II |

| | |
|---|---|
| | . . . "<br>*Col. 6, lines 40-43.*<br><br>"According to one preferred embodiment, the inventive polythioether is a difunctional thiol-terminated (uncapped) polythioether. That is, in formula II, y=0 and $R^4$ is –SH. Thus, the polythioether has the following structure:<br>$HS–R^1–[–S–(CH_2)_2–O–[–R^2–O–]_m–(CH_2)_2–S–R^1–]_n–SH$"<br>*Col. 6, lines 61-67.* |
| $R^1$ is selected from the group consisting of $C_{2-6}$ n-alkylene and a $–[(–CH_2)_p–X]_q–(–CH_2)_r–$ group; | "$R^1$ denotes a divalent $C_{2-6}$ n-alkyl, . . . or $–[(–CH_2–)_p–X–]_q–(–CH_2–)_r–$ . . . , "<br>*Col. 5, lines 31-33; col. 9, lines 16-17.* |
| $R^2$ is selected from the group consisting of $C_{2-6}$ n-alkylene, and $C_{6-8}$ cycloalkylene; | "$R^2$ denotes ..., a divalent $C_{2-6}$ n-alkyl, . . . $C_{6-8}$ cycloalkyl or . . ."<br>*Col. 5, lines 36-37.* |
| X is selected from the group consisting of O and S; | "X denotes one selected from the group consisting of O, S ..."<br>*Col. 5, line 42; col. 9, lines 16-17.* |
| m is an integer between 0 and 10; | "m is a rational number from 0 to 10,"<br>*Col. 5, line 46.* |
| p is an integer between 2 and 6; | "p is an integer ranging from 2 to 6,"<br>*Col. 5, line 48.* |
| q is an integer between 1 and 5; | "q is an integer from 1 to 5,"<br>*Col. 5, line 49.* |
| r is an integer between 2 and 10; and | "r is an integer from 2 to 10."<br>*Col. 5, line 50.* |
| n is an integer between 1 and 60 selected so that the molecular weight of the polythioether is between 1,000 and 10,000 Daltons. | "n is an integer from 1 to 60,"<br>*Col. 5, line 47.*<br><br>"Desirably, the inventive polythioethers have number average molecular weights ranging from about 500 to 20,000, preferably about 1,000 to 10,000, very preferably about 2,000 to 5,000." |

| | |
|---|---|
| | *Col. 6, lines 20-23.*<br><br>*Comment*<br>A Dalton is defined as a unit of molecular weight having one-twelfth the mass of a carbon atom in its ground state. *IUPAC Compendium of Chemical Terminology.* A carbon atom has an atomic mass of 12.011 grams per mole. Thus, for practical purposes, a Dalton is roughly equivalent to one gram per mole. One skilled in the art would appreciate that a molecular weight of a polymer is in units of Daltons. |

| *Claim 25 of the Present Reissue Application* | *Representative Support in U.S. 5,912,319* |
|---|---|
| The polythioether of claim 24 wherein $R^1$ is $C_2$-$C_6$ n-alkylene. | "$R^1$ denotes a divalent $C_{2-6}$ n-alkyl . . ."<br>*Col. 5, line 31.* |

| *Claim 26 of the Present Reissue Application* | *Representative Support in U.S. 5,912,319* |
|---|---|
| The polythioether of claim 24 where $R^1$ is $-[(-CH_2-)_p-O-]_q-(-CH_2-)_r-$ where r, p, and q are 2. | "In a preferred embodiment, X is O . . ., and thus $R^1$ is $-[(-CH_2-)_p-O-]_q-(-CH_2-)_r-$ . . . Preferably, the indices p and r are equal, and very preferably both have the value of 2."<br>*Col. 9, lines 15-19.* |

| *Claim 27 of the Present Reissue Application* | *Representative Support in U.S. 5,912,319* |
|---|---|
| The polythioether of claim 24 wherein $R^2$ is $C_2$ alkyleneoxy. | "$R^2$ denotes . . . $-[(-CH_2-)_p-X-]_q-(-CH_2-)_r-$ . . ."<br>*Col. 5, lines 36-38.* |

| *Claim 28 of the Present Reissue Application* | *Representative Support in U.S. 5,912,319* |
|---|---|
| The polythioether of claim 24 wherein the molecular weight of said polythioether ranges from about 2,000 to about 5,000 Daltons. | "Desirably, the inventive polyether has a number average molecular weight ranging from about 500 to about 20,000 grams per mole, more preferably from about 1,000 to about 10,000, and most preferably from |

| | |
|---|---|
| | about 2,000 to about 5,000,...."<br>*Col 6, lines 20-23.*<br><br>*Comment*<br>A Dalton is defined as a unit of molecular weight having one-twelfth the mass of a carbon atom in its ground state. *IUPAC Compendium of Chemical Terminology.* A carbon atom has an atomic mass of 12.011 grams per mole. Thus, for practical purposes, a Dalton is roughly equivalent to one gram per mole. One skilled in the art would appreciate that a molecular weight of a polymer is in units of Daltons. |

| *Claim 29 of the Present Reissue Application* | *Representative Support in U.S. 5,912,319* |
|---|---|
| The polythioether of claim 24 having an atomic weight percentage ratio of C:S:O of 35-49 : 20-60 : 0-20. | The polythioethers disclosed in the specification have atomic weight percentage ratios within the claimed range. For example, when $R^1$ and $R^2$ are $C_2$ n-alkylene, X=0, and m=1, a polythioether having the formula of claim 1 and an molecular weight of 3,416 Daltons where n=16, will have an atomic weight percentage ratio of C:S:O of 45.5 : 31.8 : 14.9. |

| *Claim 30 of the Present Reissue Application* | *Representative Support in U.S. 5,912,319* |
|---|---|
| A mixture of polythioether polymers comprising a polythioether polymer having the formula | "Polythioethers having higher functionality are also within the scope of the present invention."<br>*Col. 7, lines 32-33.* |
| $B–\{–S–R^1–[–S–(CH_2)_2–O–(R^2–O)_m–(CH_2)_2–S–R^1]_n–S–H\}_z$<br><br>wherein | "Polyfunctional polythioethers according to the present invention thus preferably have the formula III<br><br>$B–(A–[R^3]_y–R^4)_z$ III"<br>*Col 7, lines 52-55.*<br><br>"A denotes a structure having the formula I, y is 0 or 1, |

| | |
|---|---|
| | $R^3$ denotes a single bond when y=0 …, $R^4$ denotes –SH when y=0 . . . ," *Col. 7, lines 57-65.*<br><br>"Polythioethers as described above have a wide range of average functionality." *Col. 8, lines 36-37.* |
| $R^1$ is selected from the group consisting of $C_{2-6}$ n-alkylene, and a $-[(-CH_2)_p-X]_q-(-CH_2)_r-$ group; | "$R^1$ denotes a divalent $C_{2-6}$ n-alkylene, … or $-[(-CH_2-)_p-X-]_q-(-CH_2-)_r-$ . . . ," *Col. 5, lines 31-33; col. 9, lines 15-17.* |
| $R^2$ is selected from the group consisting of $C_{2-6}$ n-alkylene, and $C_{6-8}$ cycloalkylene; | "$R^2$ denotes . . ., a divalent $C_{2-6}$ n-alkyl, …, $C_{6-8}$ cycloalkyl …" *Col. 5, lines 36-37.* |
| X is selected from the group consisting of O and S; | "X denotes one selected from the group consisting of O, S …" *Col. 5, line 42; col. 9, lines 16-17.* |
| m is an integer between 0 and 10; | "m is a rational number from 0 to 10," *Col. 5, line 46.* |
| p is an integer between 2 and 6; | "p is an integer ranging from 2 to 6," *Col. 5, line 48.* |
| q is an integer between 1 and 5; | "q is an integer from 1 to 5," *Col. 5, line 49.* |
| r is an integer between 2 and 10; | "r is an integer from 2 to 10," *Col. 5, line 47.* |
| z is an integer from 3 to 6; | "z is an integer from 3 to 6." *Col. 8, line 2.* |
| B is a z-valent group of a polyfunctionalizing agent; and | "B denotes a z-valent residue of a polyfunctionalizing agent," *Col. 8, lines 3-4.* |
| n is an integer between 1 and 60 selected so that the molecular weight of the polythioether is between 1,000 and 10,000 Daltons. | "n is an integer from 1 to 60." *Col. 2, line 41.*<br><br>"Desirably, the inventive polythioethers have number average molecular weights ranging from about 500 to 20,000, preferably about |

| | |
|---|---|
| | 1,000 to 10,000, very preferably about 2,000 to 5,000."<br>*Col. 6, lines 20-23.*<br><br>*Comment*<br>A Dalton is defined as a unit of molecular weight having one-twelfth the mass of a carbon atom in its ground state. *IUPAC Compendium of Chemical Terminology*. A carbon atom has an atomic mass of 12.011 grams per mole. Thus, for practical purposes, a Dalton is roughly equivalent to one gram per mole. One skilled in the art would appreciate that a molecular weight of a polymer is in units of Daltons. |

| *Claim 31 of the Present Reissue Application* | *Representative Support in U.S. 5,912,319* |
|---|---|
| The polythioether mixture of claim 30 wherein z is 3. | "z is an integer from 3 to 6,"<br>*Col. 8, line 2.* |

| *Claim 32 of the Present Reissue Application* | *Representative Support in U.S. 5,912,319* |
|---|---|
| The polythioether mixture of claim 30 wherein the mixture has an average functionality between 3 and 4. | "Polyfunctionalizing agents having more than three reactive moieties (i.e., z>3) afford 'star' polymers and hyperbranched polythioethers. For example, two moles of TAC can be reacted with one mole of a dithiol to afford a material having an average functionality of 4. This material can then be reacted with a divinyl ether and a dithiol to yield a polymer, which can in turn be mixed with a trifunctionalizing agent to afford a polymer blend having an average functionality between 3 and 4."<br>*Col. 8, lines 27-36.* |

| *Claim 33 of the Present Reissue Application* | *Representative Support in U.S. 5,912,319* |
|---|---|
| The polythioether mixture of claim 30 wherein the average functionality is between 2.05 and 3.00. | "For example, trifunctionalizing agents afford average functionalities of from 2.05 to 3.0, . . . "<br>*Col. 8, lines 38-39.* |

| | |
|---|---|

| *Claim 34 of the Present Reissue Application* | *Representative Support in U.S. 5,912,319* |
|---|---|
| A curable composition comprising: | "Polythioethers according to the invention are useful in applications such as coatings and sealant compositions, and preferably are formulated as polymerizable sealant compositions in applications where low temperature flexibility and fuel resistance are important. A first preferred polymerization composition thus includes at least one polyether as described herein; a curing agent or combination of curing agents, and a filler." *Col. 11, line 61 to col. 12, line 2.* |
| 40 to 80 weight percent of a polythioether polymer according to claim 24, | "The polythioether or combination of polythioethers preferably is present in the polymerizable composition in an amount from about 30 wt % to about 90 wt %, more preferably from about 40 to 80 wt % . . ." *Col. 12, lines 3-6.* |
| 5 to 60 weight percent of a filler, and | "Fillers useful in the polymerizable compositions of the invention include those commonly used in the art, such as carbon black and calcium carbonate ($CaCO_3$). Preferably, the compositions include about 5 to about 60 wt % of the selected filler or combination of fillers, . . ." *Col. 12, lines 33-37.* |
| 10 weight percent of a curing agent. | "The compounded polymer was mixed intimately with the epoxy resin curing agent . . ., in the weight ratio of 10:1 . . ." *Col. 19, lines 9-11.* |

| *Claim 35 of the Present Reissue Application* | *Representative Support in U.S. 5,912,319* |
|---|---|
| The curable composition of claim 34 further comprising one or more additives selected from the group consisting of pigments, cure accelerators, adhesion promoters, thixotropic | "In addition to the foregoing ingredients, polymerizable compositions of the invention can optionally include one or more of the following: pigments; thixotropes; |

| | |
|---|---|
| agents, and isopropyl alcohol. | accelerators; adhesion promoters; and masking agents."<br>*Col. 12, lines 57-60.*<br><br>Examples 14 and 15.<br>*Col. 19, lines 7 and 37.* |

Accordingly, this Amendment adds no new matter.

Please grant any extensions of time required to enter this response and charge any additional required fees to our Deposit Account No. 06-0916.

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER, L.L.P.

Dated: February 25, 2004

By: _____
William R. Lambert
Reg. No. 44,857

CERTIFICATE OF EXPRESS MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service's "Express Mail Post Office to Addressee" service under 37 CFR § 1.10, in an envelope addressed to: MAIL STOP REISSUE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on February 25, 2004. Express Mail Label No.: EV 351293862 US.

Signed: _____
Linda Phillips